

Name:

ID Number:

Exam Number:

Grade: 1: ... 2: ... 3: ... 4: ... 5: ... 6: ... 7: ... 8: ... Total:

SOLVE ALL the problems IN THE SPACE PROVIDED

Read the Problems CAREFULLY!

THERE ARE 6 (SIX) PAGES THIS PAGE INCLUDED

In the exam, the following matrices MAY be used. Do not get puzzled if a reference to matrix X , Y or Z or etc arises! No problem modifies X, Y, Z, R, S in a way that missing that problem would change the answer of any other problem of the exam.

If you are asked to evaluate a MATLAB expression, and you think the result would generate an ERROR because a variable is undefined you could write **ERROR** instead of giving an answer. For example `five == 5` generates an **ERROR** since variable `five` is never defined anywhere in the exam.

$$X = \begin{bmatrix} 1 & 4 & 4 & 1 \\ 2 & 8 & 8 & 2 \\ 3 & 6 & 6 & 3 \end{bmatrix}, Y = \begin{bmatrix} 1 & 1 & 2 \\ 2 & 1 & 1 \end{bmatrix}, Z = [1 \ 2 \ 1 \ 2], R = \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}, S = [1 \ 2 \ 3],$$

Problem 1. (50 POINTS)

Give short answers to the following questions.

- (1) How many bytes in 1MB disk-space?
- (2) What is a 1KiB?
- (3) How many bytes is a MATLAB double?
- (4) How many bytes is a MATLAB char ?
- (5) How many bytes is a MATLAB logical?
- (6) What is the range of values for an 8-bit signed integer such as `int8` in MATLAB? (give number of values, lowest and highest value in the range.)
- (7) What is matrix element $X(\text{end} - 2)$?
- (8) What is array element $X(\text{end}, \text{end})$?
- (9) What is array element $Y(\text{end} - 2)$?
- (10) Represent decimal (i.e. base-10) integer 20 in hexadecimal.

Problem 2. (35 POINTS)

(a) For variable `A`, give its, value, size (shape), number of Bytes and Class (i.e. data type) as needed for the MATLAB program below.

```
>> A = 5 < 5 < 5;
>> A
>> whos A           % A = ..... Size ... x ... Bytes ..... Class .....
>> A = 2^1^2
>> A
>> whos A           % A = ..... Size ... x ... Bytes ..... Class .....
>> A = true == false + true;
>> A
>> whos A           % A = ..... Size ... x ... Bytes ..... Class .....
>> A = int16(5 < 5 + 5);
>> A
>> whos A           % A = ..... Size ... x ... Bytes ..... Class .....
>> A = 13:-3:1;
>> A
>> whos A           % A = ..... Size ... x ... Bytes ..... Class .....
```

(b) Do so for `A` below.

```
>> clear A;
>> A(4)= 14;
>> A
>> whos A           % A = ..... Size ... x ... Bytes ..... Class .....
>> A(4,4)= 24;
>> A
>> whos A           % A = ..... Size ... x ... Bytes ..... Class .....
```

Problem 3. (30 POINTS)

What is the result of the following MATLAB operations?

- (a) (5 points) `q3a = R * transpose(R);`
- (b) (5 points) `q3b = S * R;`
- (c) (5 points) `q3c = S * transpose(S);`

(a)	(b)	(c)
q3a =	q3b =	q3c =

(d) (15 points) Also provide the following information for variables q3a, q3b,q3c.

```
>> q3a;
>> whos q3a           Size ... x ... Bytes ..... Class .....
>> q3b;
>> whos q3b           Size ... x ... Bytes ..... Class .....
>> q3c;
>> whos q3c           Size ... x ... Bytes ..... Class .....
```

Problem 4. (50 POINTS)

Evaluate the following MATLAB expressions. What are the values of *q4a, q4b, q4c, q4d, q4e*?

```
>> q4a = 5 / 1 / 5 ;           q4a = .....
>> q4b = 5 < 5 < 1 ;           q4b = .....
>> q4c = NaN == NaN;           q4c = .....
>> q4d = 5 & 5 ;               q4d = .....
>> q4e = 5 + 5 & 5 < 5 ;       q4e = .....
```

Problem 5. (35 POINTS)

- (a) List the elements of *Y* in column-major filin/form.

- (b) List the elements of *Y* in row-major filin/form.

Problem 6. (40 POINTS)

(a) What is the range of values (smallest, largest possible) for q6a that is defined as follows.

```
>> q6a = round(2*rand() + 3);      % Smallest possible value for q6a = .....  
                                     %  
                                     % Largest possible value for q6a = .....
```

(b) What is the value of variable q6b defined as follows.

```
>> q6b = 2*ones(3)+eye(3) +5      % q6c = .....
```

(c) What is the value of variable q6c defined as follows.

```
>> q6c = 1:3:10                  % q6c = .....
```

(d) What is the value of variable q6d defined as follows.

```
>> q6aux = 1:5;  
>> q6d = (-1) .^ q6aux           % q6d = .....
```

(e) What is the value of variable q6e defined as follows.

```
>> q6aux = 1:5;  
>> q6e = q6aux .^ 2             % q6e = .....
```

(f) What is the value of variable q6f defined as follows.

```
>> q6f = 1:3:10 == 3           % q6f = .....
```

(g) What is the value of variable q6g defined as follows.

```
>> q6g = X(:, 1:1:2)           % q6g = .....
```

(h) What is the value of variable q6h defined as follows.

```
>> q6h = X ;  
>> q6h (:, 2:end) = []         % q6h = .....
```

Problem 7. (60 POINTS)

(a) What is the value of q7a, q7b, q7c after the sequence of the six MATLAB statements? Write down the values in the corresponding space below.

```
>> q7a = 2;
>> q7b = 10;
>> q7c = q7a + q7b;
>> q7a = 2 * q7a;
>> q7b = q7b / 2;
>> q7c = q7a + q7b + q7c ;
>> q7a                                % q7a = .....
>> q7b                                % q7b = .....
>> q7c                                % q7c = .....
```

(b) What are the values of q7d, q7f at the end of the MATLAB program below (as indicated)?

```
>> q7d = 10 ;
>> q7f = 20;
>> q7 = 0;
>> q7 = q7d; q7d = q7f ; q7f = q7;
>> q7d                                % q7d = .....
>> q7f                                % q7f = .....
```

(b) What are the values of q7g, q7h at the end of the MATLAB program below (as indicated)?

```
>> q7g = 10 ;
>> q7h = q7g + q7g;
>> q7h = q7g + q7h;
>> q7g                                % q7g = .....
>> q7h                                % q7h = .....
```

Problem 8. (33 POINTS)

The following code resides in a file named `compute.m`. Apparently it attempts to compute $e = \exp(1.0)$ using the approximation

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \dots + \frac{1}{n!}$$

implied by the Taylor expansion of $\exp(x)$ for $x = 1$. However the code is incomplete. The code uses function `cumprod()`. This computes the cumulative products of the elements of say vector x . Thus if $x = [2 \ 3 \ 4]$, then `cumprod(x) = [2 \ 6 \ 24]`. We ask you to fill the incomplete lines (Lines 5 and 6) to turn this into a correct MATLAB M-file for this computation/approximation of e . Line 7 prints the approximation of e to the desired precision/order.

```
% Compute e approximation to order n                Comment Line 1
n = input('Order of approximation ');              % Line 2
a = [1 1:n ] ;                                     % Line 3
b = cumprod(a) ;                                   % Line 4
b = ;                                              % Line 5
c = ;                                              % Line 6
disp(c) ;                                          % Line 7
```

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You may tear-off this last page and use it as scratch paper; do not turn IT in

End of Exam 1